MINIMISSION - I

INCREASING PRODUCTION

Application of nitrogen enhanced the production of perfect and male flowers and also extended the period of flowering. The yield data revealed the superiority of Kodur 13/5 over the rest. Air layers performed better than seedlings. Supplementary irrigation once in 15 days during summer months resulted increased production. Leader shoot pruning during July-August has been shown best with respect of increasing the yield of cashew.

Agr. I (176) : Nutritional studies in cashew a) Effect of graded doses of NPK fertilizers on the productivity of layers and seedlings
(RC Mandal and N. Yadukumar)

The experiment aims at investigating the nutritional requirement of cashew plants raised by seedlings and air-layers. Two trials (for-layer materials and seedlings separately) are in progress since 1978 with Nitrogen, Phosphorus and Potassium applied in three doses each using 3^3 factorial confounded design. The present dosages of the treatment revised since 1984 are :

N	250, 500, 750g/tree
P_2O_5	75, 150, 225g/tree
K_2O	75, 150, 225g/tree

Growth observations such as plant height and canopy spread recorded earlier during 1983 showed more vigorous growth for higher dosage of nutrients in the case of both seedlings and air-layers.

Yield data recorded during 1986. ie., two years after imposing the revised dosages of treatment indicated that graded doses of nitrogen was found to be highly significant with a linear trend only in case of air-layer plants. The treatment differences were not significant in the case of seedlings, mainly because of large variation in yield from plant to plant.

In confirmity with the previous years result, graded doses of nitrogen showed linear trend in crop yield only in case of air-layer plants, however, no conclusive evidence of P & K effect are noticed. The seedling plot once again showed erratic results because of large variability in yield from plant to plant. Interestingly enough the average yielding ability of air-layer plants (6.33 kg/tree) is almost three fold to that of seedling plants (2.13 kg/tree) Table I. Based on the erratic results, the separate trial with seedling progenies is proposed to be discontinued.

Table-I Yield of nuts (kg/tree)

Nutrient doses	Air-layer plot	Seedling plot
N_{250}	5.58	2.13
N_{500}	6.66	2.58
N_{750}	8.75	1.69
P_{25}	6.59	2.22
P_{150}	6.68	1.92
P_{225}	6.98	2.27
K_{75}	7.02	1.46
K_{150}	6.46	1.69
K_{225}	5.52	3.26
Mean	6.33	2.13

Agr. I (176) : (b) Response of high yielding varieties of cashew to different levels of nitrogen
(N. Yadukumar, RC Mandal and Thimmappaiah)

The experiment which is in progress since 1983 at CPCRI Regional Station, Vittal, aims at evaluating the 8 promising varieties and their response to the different levels of nitrogen. The varieties viz. WBDC-V, M 6/1, M 10/4, M 44/3, T-1-Bla, A 18/4, 13/5 Kodur and Bla-139-1 as subplot treatments: three levels of nitrogen viz., 250, 500 and 750g per plant (keeping 125g P_2O5 and 125g K_2O constant) as one factor and two types of planting material namely seedlings and epicotyl grafts as another factor constituting as main plot treatments, the trial is laid out in a splitplot design with two replications.

Observations on growth characters such as height, girth and canopy spread recorded earlier (1985) indicated that grafts growth was more vigorous than the seedlings.

Among the varieties M 6/1, M 10/4 and Bla-139-1 were found to be early in flowering, whereas the varieties M 6/1, M 10/4, M 44/3 and A 18/4 have shown profuse flowering nature. With regard to duration of flowering M 10/4, M 44/3 and A 18/4 varieties have exhibited short flowering phase. The impact of fertilizer is seen with nitrogen application causing protracted period of flowering.

Detailed observations on sex count were recorded (Table II). It is noticed that the perfect flowers ranged from 27.6 to 40.6 and male flowers ranged from 113.2 to 257.9. The varieties M 10/4 and M 6/1 have shown significantly more number of perfect flowers. However, with regard to total number of flowers, apart from M 10/4 and M 6/1 two more varieties viz. M 44/3 and 13/5 Kodur also shows significantly more number of flowers. The response to nitrogen application in increased production of perfect and male flowers is seemingly evident.

Table- II Distribution of perfect and male flowers

Treatments	Flowers/pan*	
	Perfect	Male
Varieties		
WBDC-V	30.9	146.9
M 6/1	32.5	228.2
M 10/4	40.6	257.9
M 44/3	35.9	223.1
A 18/4	35.5	205.9
T. No. 1	27.6	113.2
Kodur 13/5	39.1	213.0
Bla-139-1	30.8	150.2
Nitrogen doses (g/plant)		
250	34.5	181.4
500	30.9	185.4
750	38.0	222.9

* average values

The yield data (Table III) gives a broad indication of the better performance of Kodur 13/5 followed by the three Vridhachalam origin varieties namely M 6/1, M 44/3 and M 10/4. It also indicates the positive response to nitrogen application at the recommended dose level of 500g/plant. Comparing grafts viz. seedlings, the results are in confirmity with earlier findings that grafts perform better than seedlings.

Table III. Response of high yielding varieties of cashew to different levels of nitrogen and planting materials (Yield in kg of nuts/tree)

Varieties	Nitrogen levels			Mean	Planting materials	
	N_{250}	N_{500}	N_{750}		Seedlings	Grafts
WBDC-V	0.22	0.18	0.16	0.19	0.24	0.14
M 6/1	0.61	0.43	0.16	0.40	0.29	0.50
M 10/4	0.37	0.16	0.46	0.33	0.29	0.37
M 44/3	0.45	0.47	0.27	0.39	0.17	0.62
T. I-BLA	0.18	0.66	0.26	0.37	0.28	0.45
A-18/4	0.23	0.14	0.10	0.16	0.24	0.07
Kodur 13/5	0.30	0.53	0.75	0 53	0.32	0.74
BLA-139-1	0.23	0.52	0.04	0.26	0.11	0.41
Mean	0.32	0.39	0.28	0.33	0.24	0.41

The experiment is still initial stage and no definitive conclusions can be drawn at present. Yield data for another 4-5 years from now to reach stabilization will lead us in identifying a suitable variety which can be recommended for this region along with its nutrient requirements.

Agr. III (176) : Effect of irrigation on cashew (N Yadukumar, RC Mandal)

As such the cashew crop is an unirrigated crop. However, if minimum water resources are available, increased crop

production may be achieved by supplementing irrigation with water saving technique. Therefore, an attempt is made to study the response of cashew to supplementary irrigation during 2 flowering phases, and work out the critical stages of irrigation and economics of irrigation.

An observation trial was laid out in 1986 at NRCC Experimental Station, Shantigodu with the following treatments imposed on 13 year old cashew trees :

a) Fortnightly irrigation @ 200 litres water/tree during
   i) Nov-Jan (first flowering phase)
   ii) Jan-Mar (second flowering phase)
   iii) Nov-Mar (covering both phases)
b) Control (no irrigation)

Based on the results arrising out of this project, a full-fledged trial is proposed to be laid formulating appropriate treatments necessary for this study.

Supplementary irrigation, once in 15 days during summer months has resulted in increased crop production almost two fold as compared to no irrigation (Table IV). However, clearcut differences are not noticed for the various irrigation treatments tried.

Table IV. Effect of irrigation on cashew

Treatments	Netyield (kg/tree) Pre-Treatment AV. of. 2 years 1985 to 1986	Post treatment 1987
Fortnightly irrigation @ 200 litres/tree		
i) Nov-Jan	3.60	5.33
ii) Jan-Mar	2 92	5.82
iii) Nov-Mar	2.78	5.19
Control (no irri)	2.51	2.91

Having observed effect of irrigation during summer months on crop production, a separate trial is proposed to be laid out incorporating both irrigation and fertilizer treatments.

Agr. iv (176): Cashew based farming system-Inter and mixed cropping (RC Mandal, N. Yadukumar and E. Mohan)

The experiment envisages to maximise the economic returns in the initial period of cashew orchard establishment through cashew based farming system under rainfed conditions in the laterite soils of undulating topography.

A trial consisting of ten treatments replicated thrice was laid out in 1987 at NRCC, Puttur aiming at finding out suitable food crops, fruit crops, forest tree crops and cover crops that can be grown in the cashew plantations in the first five years. The treatments are :

1. **Annual food crops**
   Cashew + tapioca
   Cashew + pigeon pea
2. **Fruit Crops (biennial and perennial)**
   Cashew + pineapple
   Cashew + papaya
   Cashew + guava
3. **Forest tree species**
   Cashew + casuarina
   Cashew + subabul
   Cashew + acacia
4. **Cover crops**
   Cashew + mucuna
   Cashew only (control)

Among the annuals, tapioca has yielded 6.25 tonnes of tubers/ha (duration 10 months) and pigeon pea yielded 0 2 tonnes/ha (duration four months). The stand of other fruit crops and forest tree species are establishing well and

showing compatibility. The cover crop *Mucuna bracteata* has just covered 25 per cent of the ground space. The experiment is still in initial stage. The economic evaluation will be undertaken after 5 years to suggest the suitable crop combinations that can be grown in the cashew-based farming system.

Hort. II (176): Effect of time and severity of pruning in cashew (E Mohan)

Cashew yield mainly depends on the canopy structure and the extent of potential lateral shoots that arise on the leader shoots during the active growth phase. Orchard management techniques such as pruning helps in activating the dormant buds and putting forth more number of potential laterals resulting in increased production of hermaphrodite flowers and fruit-set. To study this aspect and to fix the exact time and suitable method of pruning aiming at increased production, a field trial laid out in Randomised Block Design with three replications, is in progress since 1984. Nine year old seedling progenies of M 76/2 (VTH-539) with average yield potential of 5 kg/tree constituted the experimental material. Two methods of pruning namely Lateral shoot (mild) and Leader shoot (severe) pruning was done during May to August in 1984 and 1985. About 60 percent of the shoots were pruned per tree and the weight of biomass was recorded. It was earlier observed that the leader shoot (severe) pruning during July and August months significantly outyields over the rest and almost doubled the yield as compared to 'no pruning'. Pruning was discontinued during 1986 to study the after-effect of pruning.

The yield data for post-treatment period recorded in 1987 showed a similar trend to that of treatment period ie., leader shoot pruning during July and August are found to be the best (Table V). It was observed that the yield potential of all the pruned trees is on the increase.

One more year's observation to study the real impact of after effect of pruning and a separate large scale observation trial for field testing the efficacy of leader shoot pruning in July and August months have been planned.

Table v. Effect and after effect of pruning

Treatments Month	Shoot pruning	Av. yield/tree* for years 1984-85 and 1985-86 (kg)	post-treatment yield/tree (kg)
May	Lateral	5.14	7.94
	Leader	3.26	9.00
Jun	Lateral	4.91	8.52
	Leader	6.07	12.36
Jul	Lateral	4.24	5.90
	Leader	9.22	13.03
Aug	Lateral	7.98	8.26
	Leader	9.36	12.75
Control		4.32	5.15
CD (P=0.05)		2.90	—

*Significant at 5% level

Phy. III (176): High density planting of cashew (N. Yadukumar E. Mohan and L. P. Misra)

This project aims at understanding the growth behaviour and production potential of cashew under high density planting system with major emphasis on evaluating and recommending the most suitable density of planting cashew trees that may increase the crop production per unit area.

The experiment was laid out at NRCC Experimental Station (erstwhile CPCRI Cashew seed Farm), Shantigodu during

1982 with five treatments (spacing of tree planting 8×8m, 6×6m, 4×4m, 3×3m, and 2×2m accommodating 156, 278, 625, 1111 and 2500 trees/ha respectively) replicated five times.

Growth measurements such as trunk, girth, tree height and canopy spread recorded earlier (1986) have indicated that trees spaced wider, grew better as they were free from competition. Based on the canopy spread it was estimated that the trees in 2×2m, spacing have fully covered the given area whereas trees in 8×8m, spacing have covered only one-sixth of the ground area and trees in 3×3m spacing covered seven-tenth of the ground area. As the area in 2×2m spaced covered fully, pruning (on an average 23 ± 2.4 kg/tree fresh pruning weight) was carried out during August, 1986. This was done to avoid over crowding of trees and also to train the trees like "modified leader system".

Closely spaced trees (in 2×2m, 3×3m and 4×4m spacing) yielded significantly more nut production per unit area than the widely spaced trees (Table VI). The canopy of the closely spaced trees (2×2m and 3×3m spacings) have completely covered the interspaces and therefore it is proposed to cut and remove the alternate row in these plots, after observing the yield pattern in the ensuing season.

Table - VI Yield of cashew in high density planting (Kg)

Treatments (spacing)	Nut weight/plot	Nut weight/ha
8×8m	6.05	181.50
6×6m	7.55	226.50
4×4m	19.75	592.50
3×3m	25.26	757.80
2×2m	26.00	780.00
Mean	16.92	
CD	10.61	

Ent. III (176) : Chemical control of pests of Cashew (P S P V Vidyasagar and D. Sundararaju)

The experiment envisages to evolve suitable chemical control schedules for combating the major pests of cashew effectively and economically. This work was initially started at CPCRI Kasaragod during 1972-'73 aiming the pest management of the serious pests of cashew like Tea mosquito *(Helopeltis antonii)* and cashew stem and root borer *(Plocaederus ferrugineus.)*

Field control trials against this pest using insecticides like endosulfan, fenitrothion malathion + fenitrothion and phosphamidon each at two levels viz. 0.1% and 0.2% when applied as low volume sprays revealed that endosulfan at 0.1% was effective in reducing pest incidence on the inflorescence during 1974-'75. Another field control trial using quinalphos diazinon, formothion and endosulfan at 0.05% concentration was conducted at Kasaragod for three consecutive seasons (1975–'76 to 1977-'78) also revealed that endosulfan as the most effective insecticide in controlling pest population, followed by quinalphos and formothion. A trial with six insecticides viz. endosulfan, monocrotophos, quinalphos, formothion phosalone and fenthion at 0.05% each was evaluated against this pest at Goa during 1981–'82 season. Among them endosulfan 0.05% recorded least damage followed by monocrotophos, quinalphos and phosalone.

The prophylactic control trial against cashew stem and root borer using cashew nut shell liquid and coal tar individually and in combination with aldrin 1% was

laid out at Karnataka Government Forest Plantation, Koila during 1974-'75. The treatment involves application of above materials to the trunk zone (including exposed portions of roots also) up to a height of 60 cm., twice in April-May and October-November.

Field trials on curative control of stem and root borer using BHC, carbaryl pyrithrin, piperomay buloscide, diamethoate trichlorophin feniprothion, dichloroos applied as injections and drenching the base), phorate granules and aluminium phosphide tablets (applied into the tunnels on the stem) reveal that the success of the curative treatment depends much on the intensity of infestation. Eventhough most of the above insecticides are quite effective in controlling the grubs, the trees in the medium and advanced stages of infestation cannot be saved. If infestation is detected in the early stages even swabbing with BHC 0.1% suspension after removal of the affected tissues which harbour immature stages of the pest is quite effective. The dead trees and those which are beyond recovery should be removed from the plantation for checking the multiplication of the species.

Studies on stem and root borer control :

(a) Chemical Control

The padding method of application of monocrotophos @ 30 ml/tree and application of BHC 10% dust @ 500g/tree in and around the hole of the trees were done at CPCRI, Regional Station, Vittal campus. A total of 39 trees were treated during January to April. During the last round of observation taken in December 1987, it was recorded that 38.5% trees (15/39) were free of infestation (Table VII)

Table-VII. Chemical control of stem borer

Stages of infestation	No. of treatment	No. of trees removed	% of control
1. Early	23	9	39.1
2. Middle	10	5	50.0
3. Advanced	6	1	16.7
Total :	39	15	38.5

(b) Effect of DD-136 Nematode on the grubs of stem borer :

The stem borer grubs maintained in the laboratory were exposed to DD - 136 culture @ 25, 50 and 100 nemas/g body weight through application of culture to the cashew bark. After 15 days of treatment, mortality in the grubs was observed. However, after 30 days of treatment, 20% mortality occured in all treatments except control. In treatments with higher doze of 50 and 100 nemas/g, 40% mortality was noticed (Table VIII)

Table-VIII Effect of DD-136 nematode on stem and root borer (grubs)

Sl. No.	Treatment (dosage nemas/g)	% of mortality 15 days	30 days	45 days
1	@ 25	Nil	20	20
2	@ 50	Nil	20	40
3	@ 100	Nil	20	40
4	Control	Nil	Nil	Nil

MINIMISSION - II

INCREASING PRODUCTIVITY

A National Gean Bank on cashew has been established with 86 clonal accessions at Puttur. Three selections namely VTH 30/4-1, 40/1-1 and 107/3-1 have been identified among the germplasm having an yield of more than 8.5 kg/tree/year. Hybrid plants exhibiting very high yield potential have been identified. Two selections of the seedling progenies from Vridhachalam (M 10/4 and M 44/3) have recorded maximum yield in comparative yield trial, planted at Vittal. Biochemical analysis of tender tissues from tolerent (Tr. No. 24) and susceptible accessions revealed that the proline and neutral lipid were higher on susceptible accession. When the stem and root borer grub of cashew was exposed to DD-136 culture at 25, 50 and 100 namas/g body weight, a maximum of 20-40% mortality of the grub was observed. In vitro digestibility of cashew kernel protein from 21 varieties revealed significant varietal difference. Softwood grafting has been recommended for commercial multiplication.

Gen. 1 (176) : Collection, conservation, cataloguing and evaluation of cashew germplasm(KRM Swamy, Thimmappaiah)

The project which was initiated during 1972 at CPCRI Regional Station, Vittal envisages the collection and maintenance of diverse genotypes mainly to utilize the genetic stock for crop improvement and also to serve the interests of cashew research workers in supplying the germplasm material required for screening/evaluation purpose.

Till the establishment of NRCC (1986) altogether 292 accessions have been collected of which 161 accessions have come into a replicated trial at CPCRI Regional Station, Vittal and the remaining 131 accessions are maintained at NRCC Experimental Station (erstwhile CPCRI Cashew Seed Farm) Shantigodu. This includes related species such as *A. microcarpum A. Pumilum* and *A. orthonianum*. Fourteen accessions namely VTH-2, 3, 4, 11, 12, 16, 20, 30, 34, 50, 77, 93 and 150 identified for various desirable characters have been utilised as parents in the hybridization programme.

Presently the NRC for Cashew has taken the lead in establishment of a National Cashew Gene Bank (NCGB) at its headquarters, Puttur, with clonal progenies. Fiftysix accessions selected for evaluation from the existing germplasm collections maintained at Shantigodu have been clonally multiplied and planted during 1986 in the NCGB bearing new numbers NRC 1-56.

Ten collections were made from Dharwar Kannada district of Karnataka which consist of diverse genotypes with desirable characters such as high yield potential (10.75 kg), bold nut (11-16 g), high shelling percentage (30-31%), low kernel count (157-168/lb), big apple (200-250 g), thin shell, CNSL free, purple plant and field tolerance to tea mosquito bug.

Six accessions evaluated from existing germplasm of Shantigodu and 24 accessions from collection surveys in Goa, were clonally multiplied and added to NCGB assigning numbers NRC 57-62 and NRC-63-86, respectively. The field establishment of the NRC-1-56 accessions planted during 1986 is to the tune of 98% of which 11% of the grafts have produced panicles.

Characterisation of 292 accessions (seedling progenies is in progress. The following tree-wise observations were recorded. Plant habit, branching type, trunk girth, canopy shape, leaf length, leaf breadth, number of laterals per leader, date of first flowering, date of last flowering, panicle shape, panicle length, panicle breadth, number of fruits per penicle, coherence of nut to apple, apple colour, apple shape, apple weight, 100 nut weight, shelling percentage, kernel count/lb. and yield/plant. The range of variability recorded for some of the characters is given in Table 2-1. Among the other related species of Anacardium, *A. Pumilum* has shown dwarfing habit. As it is a very desirable character in cashew plantation, this can be exploited in hybridization programme.

Sixteen elite trees of which 10 from Vittal and 6 from Shantigodu based on the norms of high average yield and bold nut have been identified from the germplasm accessions. Seven of the 10 elite

Table 2.1. Range of variability/description recorded for some of the characters in the cashew germplasm

Character	Range
Flowering season	October-January
Flowering duration	40-127 days
Harvesting duration	36-105 days
Apple colour	Yellow, Pink, Red
Apple shape	Round, Pear, Long
Apple weight	30-150 g
Coherence of nut to apple	Loose, Tight
Nut weight	2.4-12.0 g
Apple : Nut ratio	4 : 1-12 : 1
Kernel : whole nut ration (shelling percentage)	19.0-35.0
Kernel weight	0.4-2.4 g
Kernel count/lb	180-1200
Shell thickness	1.5-4.0 mm

trees identified from Vittal accessions have exhibited yield potential over 8 kg and nut weight above 7 g. This includes the three selections namely, VTH 30/4-I, 40/1 I and 107/3 I which are proposed for release in the Karnataka region because of their consistent better performance over last 10 years. Among the 6 elite trees identified from Shantigodu accessions, VTH 174/48 and VTH 539/2 are observed to have yielded consistantly high during the last nine years. The nut yield during 1987, mean yield, average nut weight, shelling percentage, kernel count and flowering habit, for these selected 16 elite trees are given in Table 2.2.

Fresh collections from unexplored areas, continued evaluation of the existing germplasm for identification of diverse genotypes, computerisation of descriptor data and establishment of scion bank for the elite materials are some of the areas at work proposed during next few years.

Table 2.2 Elite trees identified from the germplasm accessions

Tree No./Source of material	Mean yield (kg) 1987 10 years+ mean		Mean wt/ nut (g)	Shelling%	Kernel count/ lb	Flowering Season	Flowering Duration
VITTAL ACCESSIONS							
VTH 13/2 I M 76/1	29.00	11.74	7.0	25.0	261	Mid	Long
30/4 I A 18/4	10.65	8.30	7.5	25.0	239	Mid	Long
40/1 I 2/9 Dicharla	7.10	8.85	9.2	28.6	212	Mid	Midium
50/2 I 9/8 Epurpalam	8.35	9.60	7.8	27.0	215	Early	Short
59/2 I 13/8 Kodur	17.60	9.74	7.1	24.2	254	Mid	Long
92/2 I 13/8 Chendiputuka	11.30	6.50	8.0	27.9	197	Mid	Short
105/2 I 3/3 Simhachalam	18.75	8.42	7.2	30 0	216	Mid	Long
107/3 I 3/8 Simhachalam	25.30	9.02	7.6	28 8	217	Mid	Medium
118/4 II 11/14 Karur	11.30	4.92	8.0	27.6	202	Late	Long
155 Layer tree No. 44 Vittal	4.00	—	8 7	26.2	206	Mid	Short
SHANTIGODU ACCESSIONS							
VTH 126/15 (1546) T. No. 39	10.50	7.10	8.3	32.9	163	Late	Medium
129/9 (1011) Tree No. 275	7.20	6.20	9.4	29.3	166	Late	Medium
174/48 H 4-7	21.00	8.40	5.8	33.6	234	Early	Long
194/12 H5/11 (56 Sc)	3 90	5.60	9.5	30 7	156	Late	Long
539/2 (1979) M 76/2	23.90	6.70	6.7	28.3	240	Late	Long
652/15 (2122) 871/0-6 Peria	6 80	6.00	8.8	27.4	241	Late	Long

* Early = Oct-Nov
Mid = Dec.
Late = Jan.-Feb.

Short = 40-60 days
Medium = 61-80 days
Long = More than 80 days

\+ Mean yield for Shantigodu accessions are based on 9 years data (1979-'87)

The field establishment of grafts in the comparative yield trial with clonal progenies of 12 recommended varieties and the maximisation plot with M 10/4 and M 44/3 are quite satisfactory with more than 95 percent of them have commenced flowering.

The trial with seedling progenies of 16 cashew types at Vittal were evaluated on the completion of 15 years of orchard life. Both on cumulative yield average and on 1987 yield(Table 2.3) M 10/4 and M 44/3 were found to be high yielding with a cumulative yield of 45.3 and 41.6 kg/plant (11 years), respectively (4.1 and 3.8 kg/plant/year resp.) Apart from high yielding nature, they had desirable attributes to be dwarfing habit, compact canopy and medium nut size. In flowering, they were mid-season types with medium duration. M 44/3 has been found to be prepotent and suitable for seed propagation. The experiment has been concluded.

Stat. III (176) Developing an yield index for cashew (S. Bhagavan)

Assessment of any treatment effect or comparison of tree performances among various varieties/accessions aiming at in increased crop production/ productivity must be based on sound statistical analysis of data. In cashew, one observes that the actual yield, may not represent the true potential yield, because of large variations in canopy growth which is a resultant of several extraneous uncontrollable factors such as mortalities in the neighbouring plot, trees planted in slopes of different gradation etc. In such cases, the basic assumption of trees grown under uniform condition is violated for drawing any valid inferences from the data.

Therefore, this project is envisaged to develop an yield index for cashew which gives weightage to some of the interrelated characters.

Table 2 3 Performance of 16 Cashew types in comparative yield trial at Vittal (1987)

Variety (VTH No.)	Source	Mean yield/plant (kg)	Av. wt./nut (g)	Shelling %	Kernel count/ lb.
Ansoor-I (1)	Vengurla	2.47	4.9	23.9	390
Vetore-56 (2)	Vengurla	3.90	5.2	24.4	373
WBDC-V (3)	Vengurla	3.73	4.7	27.0	333
Moregaon-I (4)	Vengurla	3.55	4.8	25.4	436
M 6/1 (10)	Vridhachalam	4.65	4.9	26.0	355
M 10/4 (11)	Vridhachalam	7.46	5.0	26.8	348
M 44/3 (12)	Vridhachalam	5.97	5.1	28 9	316
M 76/1 (13)	Vridhachalam	3.34	4.6	24.7	400
Tree No. I (34)	Bapatla	6.54	5.2	25.3	339
Tree No. 40 (35)	Bapatla	4.21	4.8	26.4	336
Tree No. 56 (36)	Bapatla	3.61	5 5	24.3	328
Tree No. 273(37)	Bapatla	3.44	5 2	26.5	313
Bla-139-1 (150)	Anakkayam	2.40	4 9	25 5	334
Bla-256-1 (151)	Anakkayam	2.36	5.3	23.9	350
Bla-266-1 (152)	Anakkayam	3.38	4.4	26.2	379
H-3-17 (153)	Anakkayam	3.17	5.6	24.3	320
Mean		3.95			
CD for P. 0.05		2.48			

100 trees were selected for this purpose and observations on height of the tree, spread on both East-West and North-South direction, number of fruits/unit area in 4 selected spots of the tree, number of fruits/unit area in 4 random spots of the tree, hundred nut weight and the actual yield (wt. of nuts) were recorded.

For preliminary analysis, following five characters were considered namely height of tree (X_1), canopy growth (X_2) which can be approximated to a constant multiple of product of EW and NS spread, Average number of fruits / unit area (X_3), hundred nut weight (X_4) and yield (X_5).

The correlations worked out for these 5 characters are :

	X_2	X_3	X_4	X_5
X_1	0.32	0.01	0.23	-0.12
X_2		0.24	0.24	0.25
X_3			0.09	0.26
X_4				-0.59

Further attempts will be made to study the direct and indirect effects in order to measure the indicative contribution at each factors.

2) Another study which aimed at field evaluation of yield forecast model of cashew from the plantations was taken up for 3 plots.

For the individual trees, yield forecast model proves to be quite satisfactory (3% deviation) whereas when applied for the entire plot, the deviation is to the tune of 12%).

Phy. V (176) : Quality evaluation in cashew (K. V. Nagaraja)

The project aims at the biochemical characterisation of the cashewnut and apple of the released and pre-released promising varieties. This project was started at CPCRI Regional Station, Vittal during 1984 and a total of 16 accessions planted under Comparative Yield Trial have been characterised with respect to kernel protein, sugars starch, amino acids, etc. Cashew apples from these accessions have also been characterised with respect to ascorbic acid, sugars, aminoacids, phenols and tannin. Cashewnut shell liquid from above accessions was estimated as phenol and reported. The details of work carried out in this project is given in Table-I.

Biochemical analysis done in the apples of 16 high yielding varieties have revealed variation between accessions with respect to abscorbic acid, phenols and tannin. However variation in sugars and amino acid was not significant. The accession M 10/4 is having maximum amino acid and sugar with comparatively less tannin. The protein content among the varieties varied from 33%-43. 76% (WBDC-V). M44/3 and Tr.50-B1a contained more than 50% aminoacids and for rest of the characters, the variation was non-significant.

Plot	No. of trees (N)	For 20 selected trees: Est. av. yld. (kg)	Act. yld. (kg)	Over est. Und. est. %	For the plot: Est. av. yld. (kg)	Act. yld. (kg)	Over est. Under est.	XnXn	
1	140	77.0	75.0	2.7 (OE)	459.07	410.38	11.9 (OE)	1.65	1.41
2	127	118.0	122.2	3.4 (UE)	515.34	415.58	24.0 (OE)	2.45	1.69
3	267	86.8	90.2	3.8 (UE)	1063.35	825.96	28.7 (OE)	1.70	1.55

1) Varietal resistance to tea mosquito bug (TMB)

The screening of the germplasm against tea mosquito was continued and a total of 5 accessions were studied for their reaction to this bug (Table 2.7). They showed a reaction from Moderately Susceptible to Highly Susceptible. In the laboratory, the tolerant types showed feeding lesion on the mid-rib, where as the susceptible showed marks on leaves, shoot and midrib. The difference in the cuticle of these types are being studied.

Table-2 7 Reaction of TMB to different cashew accessions

Accession	Score	Reaction
1. VTH-17	4.1	Moderately susceptible
2. VTH-16	5.0	Susceptible
3. VTH-14	6.1	Highly susceptible
4. VTH-79	7.0	Highly susceptible
5. VTH-157	7.0	Highly susceptible

The tolerant types (eight no.) collected from Goa and KCDC Kunthur have been planted in a block for future studies.

2. Biochemical characterization

Samples from both tolerant (Tr. No. 24) and susceptible trees collected from KCDC Kunthur were analysed for the various biochemical constituents such as phenols, O-dihydroxy phenols, sugars, aminoacids and proline and relative distribution of organic acid and lipids (Table-2.8)

3. Mass rearing of Tea mosquito bug

Standardized technique of rearing TMB in the laboratory was continued and with the present technique, it was found that the nymph population can be maintained up to 709 (Table-2.9). Due to high temperature in the summer, the mortality in early instars was high and hence only 18 nymphs were maintained during May.

Table-2.8 Biochemical analysis of succulent tissue

Biochemical Constituents	Leaves		Shoots	
	Tolerant (Tr. No. 24)	Susceptible	Tolerant (Tr. No. 24)	Susceptible
1. Phenols (mg/g)	1.56 ± 0.32	1.37 ± 0.13	0 4 ± 0.076	0.31 ± 0.046
2. O-dihydroxy-phenols (mg/g)	0.468 ± 0.078	0.527 ± 0.05	0.09 ± 0 019	0.09 ± 0.01
3. Sugar (mg/g)	17.0 ± 49.4	14.9 ± 2.38	13.8 ± 2.85	12.9 ± 1.62
4. Aminoacid (mg amino N/8)	0.154 ± 0.02	0.234 ± 0.075	0.075 ± 0.13	0.178 ± 0.04
5. Proline (mg/g)	0.046 ± 0.008	0.08 ± 0.07	0.027 ± 0 003	0.039 ± 0.003
6. Organic acid (% of total)				
citric	22 6	22.8	13.1	17.6
oxalic	77.4	77.2	86.9	82.4
7. Lipids (% of total)				
Neutral	29.5	44.9	35.0	39.9
Glyc	27.7	21.3	20.9	13.5
Phospho	42.8	33.7	44.0	46.5

Table-2.9 Laboratory rearing of TMB

Sl. No.	Month	No. of instars maintained
1	Jan 1987	709
2	Feb 1987	371
3	Mar 1987	216
4	Apr 1987	220
5	May 1987	18
6	June 1987	215
7	July 1987	150
8	Aug 1987	137

4. Population dynamics of Tea mosquito bug in the laboratory

As in the previous year, in all the months, from January-August, females were outnumbered by male in the ratio of 1:2.20, 1:1.61, 1:1.46, 1:1.69, 1:1:6, 1:1.98, 1:1.61 and 1:1.27 respectively.

Hort. III (176) : Propagation studies in cashew (Room Singh)

The project was initiated during 1977 at NRCC Experimental Station (erstwhile CPCRI Cashew Seed Farm), Shantigodu. It aims at standardising the techniques of vegetative propagation of cashew determining the optimum time for each method, studying the feasibility of rejuvenating unthrifty young and adult trees through side grafting or top working and comparing the performance of orchards raised through seedlings and air-layers.

An observational trial to study the relative performance of layers vs. seedlings which was initiated in 1977 has indicated the superiority of air-layers. The air-layer plot gave 31.2% increased yield over seedling plot.

Techniques have been standardised for air-layering, patch budding, epicotyl grafting, softwood grafting and veneer grafting. The suitable period for each of these methods are as follows:-

Method	period
Air layering	Jan-Mar
Patch budding	Apr-May
	Oct-Dec
Epicotyl grafting, softwood grafting, veneer grafting	June-Sep

The most notable achievement of this project for the work carried out in 1985 and 1986 is the success of vegetative propagation in cashew. Among the various methods of vegetative propagation tried, soft-wood grafting method was found to be the best with an average success of over 60% and the success percentage being more than 80% for the grafting done in monsoon months.

Standardisation of grafting techniques

The two methods namely softwood and epicotyl grafting were again tried on large scale for confirmity of the results achieved during the previous years. The veneer grafting method was not attempted as it did not give satisfactory results during 1985 and 1986. Among the two methods, softwood method once again reaffirmed the superiority with an average of success of 67.89% as against 30.23% success in case of epicotyl method. (Table 3.1)

Table 3.1 Propagation methods and its success

Year (1987)	Softwood			Epicotyl		
	No. done	No. success	success %	No. done	No. success	success %
Feb	400	121	30.25	400	73	18.25
Mar	1400	596	42.57	400	87	21.75
Apr	2700	1568	58.07	400	98	24.50
May	1690	1038	61.42	400	116	29.00
June	2060	1382	67.09	400	146	36.50
July	4610	3909	84.79	400	175	43.75
Aug	5200	3942	75.81	400	159	39.75
Sep	5000	3528	70.56	400	138	34.50
Oct	1950	1285	65.89	400	127	31.75
Nov	1290	488	37.85	400	90	22.50
Total :	26300	17857	67.89	4000	1209	30.23

With regard to the period of propagation, July month proved to be best with 84.79% success for soft-wood method and 43.75% success for epicotyl method. However, monsoon months (June-Sep.) gave better success percentage for both the methods.

Top Working :

Top working to rejuvenate unthrifty cashew trees into desirable high yielding variety was attempted. Thirty two trees were headed back and 27 top worked trees among them have survived with success percentage of more than 80% when top worked during Apr-July. Every sprouted tree gave 30 to 50 sprouts after about 60 days after beheading. The grafting was done from June to September 1987. The excess sprouts were removed and only 12 to 15 sprouts per tree were grafted by softwood method so that a minimum number of 4 to 5 grafted shoots may be obtained in the final selection.

Nipping of leaves :

An observational trial was conducted to study the effect of nipping one or two pair of leaves in the seedlings before the grafting is done. A total number of 1750 seedlings were nipped off and the results indicated that nipping off leaves whether one or two pair of leaves is determined to normal growth with success percentage of grafting done during October giving 58% and 53% respectively whereas the control gave 75.6%.

Extn. I (176) : Training of extension and research workers and farmers (Room Singh, RC Mandal and KRM Swamy)

Since 1983 training programmes on cashew production technology and vegetative propagation are being conducted regularly for research and extension workers and farmers. Till 1987, five training programmes (5 days duration) on cashew production technology and ten training programmes on vegetative propagation of cashew have been conducted (Table-3.2)

Table-3.2 Training programmes conducted on cashew production technology/ vegetative propagation of cashew since 1983 under MSCP

Training programme	Date	Duration (days)	No. of participants		
Cashew production technology	18-24 Apr '83	7	22		
	24-28 Apr '84	5	7		
	11-15 Dec '84	5	2		43
	7-11 Jan '86	5	5		
	6-9 Jan '87	4	7		
Vegetative propagation of cashew	4-7 Oct '83	4	12		
	11-14 Sep '84	4	5		
	14-17 Nov '84	4	4		
	6-9 Aug '85	4	3		
	3-6 Sep '85	4	3		84
	8-11 Oct '85	4	2		
	5-8 Aug '86	4	6		
	21-24 Oct '86	4	2		
	28-31 Jul '87	4	19		
	25 28 Aug '87	4	28		

A total of three training programmes viz. one on "Cashew Production Technology" and two on "Vegetative propagation of Cashew" were organised for field workers and developmental agencies in order to popularise improved package of practices for cashew and to establish

budwood orchards and nurseries for cashew. Fifty four officials belonging to the organizations such as NABARD, Central State Farms, Department of Agriculture / Horticulture from different States, Agricultural Universities, Forest Plantation Corporations/ Forest Development Corporations/Cashew Development Corporations have participated and undergone the training (Table 3.3)

Also a 6 months training programme on "Cashew Cultivation has been imparted to a foreign trainee Mr. Pham Van Nguyen from Vietnam under the ITEC programme.

Table-3.3 Training programme conducted during 1987 at NRCC, Shantigodu

State	Cashew production technology 6-9 Jan	Vegetative propagation of cashew 28-31 July	25-28 Aug
Karnataka	—	2	15
Kerala	3	2	3
Tamil Nadu	—	6	3
Andhra Pradesh	2	1	1
Madhya Pradesh	1	2	2
Maharashtra	1	2	—
West Bengal	—	4	—
Gujarat	—	—	2
Goa	—	—	2
Total	7	19	28

3.1 (443)Production of parental materials and breeders stock of cashew (EVV Bhaskara Rao)

The objective of this project is to coordinate the production of planting materials of released varieties in cashew in different University centres and National Research Centre for Cashew, in order to support the cashew development programmes in the country. During the VII Plan under the centrally sponsored schemes, it is proposed to establish a total of 45 units scion banks in different cashew growing states, namely Kerala (9 units) Karnataka (7 units), AP (6 units), Tamil Nadu (11 units), Maharashtra and Goa (3 units) and Orissa and West Bengal (9 units) This programme was taken up by different implementing agencies during 1986 and 1987. The University centres at Madakkathara (KAU) Bapatla (APAU) and Vengurla (KKV) and NRCC have taken up generation of planting materials to support this programme. Vengurla centre has produced a total of 42,240 grafts of varieties V-1 to V-5 of which 10,180 were supplied to different government agriculture / horticulture departments and forest development corporations. Madakkathara centre could produce 1520 grafts of BLA-139-1, NDR-2-1, K-22/1, H-3-13 and H-3-17 of which 800 grafts were supplied to the Government agencies for establishment of budwood orchards. Bapatla centre has released BPP-1 to BPP-6 varieties for cultivation in Andhra Pradesh and 3000 grafts of these varieties were produced during 1986-'87. About 2000 grafts of these released varieties were supplied to different agencies for establishment of budwood orchards as well as clonal orchards. The NRCC has supplied major portion of the demand from implementing agencies of centrally sponsored schemes. The materials supplied in different varieties is as follows :

SUMMARY REPORT OF AICCIP

All India Co-ordinated Cashew Improvement Project has seven centres with a budget allocation of 53.33 lakhs during VII Plan. The major achievements of the progress are summarized below :

CROP PRODUCTION

Breeding :

Germplasm collections are being maintained at all the centres. A total of 127 germplasm collections are available at Bapatla, 47 at Bhubaneswar, 75 at Chintamani, 81 at Jhargram, 93 at Madakkathara 157 at Vengurla, and 179 at Vridhachalam. Based on evaluations carried out so far a number of elite types were identified at Bapatla (T. No. 71; T. No. 210A, T. No. 209), Madakkathara (M-1-2, A-6-1 and A-6-2) and Vridhachalam (M 26/1, M 15/4 and M 26/2) which have high yield potential. In the varietal evaluation trials superiority of released varieties from Bapatla, Vengurla and Madakkathara was confirmed. In addition, at Bhubaneswar, T-40, Vengurla 36/3, M 10/4 and Hy 2/12 were found to perform consistently better than all other types. BLA-39-4 was identified as best yielder under Jhargram (West Bengal) conditions.

Priority has been to breed bold sized nuts in hybridization programmes. At Madakkathara two hybrids No. 1602 and 1591 produced nuts with 10 g nut weight. These hybrids also recorded an yield potential of 24-29 kg/tree/year in 13th year of orchard life with an average yield of 8-10 kg/tree (10 year average). Hybrid 1598 recorded best mean yield (for past 10 years) of 13.3 kg with a shelling percentage of 40% which is probably the highest recorded at any centre. At Vengurla Hybrid No. 38 and 24 recorded highest yields. At Bapatla in addition to 2/16 and 2/15 reported earlier, 3/13 and 3/5 were identified as promising hybrids with 5 to 6 g nut weight.

Horticulture:

Standardization of vegetative propagation is in progress at all the centres. Subsequent to Horticultural Group meeting in August, 1986, all the centres except Chintamani, adopted softwood grafting with higher percentage of success. At Bapatla 61-87 percent success was recorded in November to March. At Jhargram September and November months recorded highest success (27-32%) in softwood grafting and 70% success in *in situ* grafting in the month of September. Side grafting was also found to be successful in the same month. At Madakkathara success ranged between 42 to 47 percent in May-June and October. Varietal differences were noticed in studies on varietal response to softwood grafting. Adopting softwood grafting technique, Vengurla centre has produced over 40,000 grafts of released varieties.

CROP MANAGEMENT

Manurial trials are in progress at five centres. At Jhargram the data on manurial trial indicated that increasing levels of nitrogen significantly influenced nut yield and plants receiving highest

level of nitrogen (600g N/plant/year) gave 83.2 percent more yield over lowest. dose (200g N/plant/year) NxP and NxK interactions were significant and best yield was recorded in N_3 P_2 K_3 (600g N, 300g P_2O5 and 300g K_20). In older plantations which was unfertilized in initial years (9 year old) response to nitrogen was marked. At Vengurla NxP interactions were significant and N_2 P_1 K_0 (300g N, 200g P_2O5) gave best yield. At Vridhachalam also NxP interactions were significant, confirming that for realising response to higher level of nitrogen application of phosphorus is necessary. Dose of 500g N and 200g P_2O5/plant/year was found to be the best. Considering the mandays required and response to different methods of fertilizer application, it was concluded that broadcasting the fertilizer in entire drip zone in circular band application between 1.5 to 3.0m from trunk is most efficient and economical.

CROP PROTECTION

For the control of tea mosquito, endosulfan, monocrotophos, carbaryl, and methyl parathion were effective in different locations. Pooled analysis of four years data of Madakkathara indicated that while quinalphos, endosulfan, monocrotophos and dimethoate are equally effective, the yields are higher in plots treated with quinalphos.

The control of pests in foliage and fruiting season monocrotophos was found to be effective at Bapatla, for control of flower thrips and leaf miner, endosulfan quinalphos and methyl parathion were effective at Madakkathara centre and for flower thrips monocrotophos, carbaryl and dimethoate at Vengurla.

In the studies on stem and root borer best method of prophylactic treatment was found to be coal tar+kerosene application on trunk at Vridhachalam, while carbaryl application gave best protection at Vengurla. Both stem padding and root feeding of monocrotophos were found to be effective when treatment was given in early stages of infestation.

Ent. IV (176) : Studies on the root and stem borers of cashew
(Mariamma Deniel)
1983 to 1986

ACCOMPLISHMENTS

This project was initiated during 1983 at CPCRI, Vittal to study in detail the life cycle of the root & stem borers of cashew with a view to control the pest population by Chemical control and Biological means.

a) Biology :

The biology of *Plocaederus ferrugineus* (L.) *(coleoptera :* Cerambycidae: Cerambycinae) was studied in the laboratory. The egg is oval, pale white in colour (length 4.12 mm and breadth 1.9 mm). Seven and six instars in grub phase of female and males, respectively were observed. The prepupal grub makes a chamber with powdery frass and a calcareous cocoon within the chamber. Sometimes, chamber and cocoon were not formed, but excretion of calcium carbonate was seen around the prepupal grub and the pupae gradually moulds into a open pupa. The length and breadth of cocoon was 3.9 and 2.1 cm, respectively.

Dimorphism is seen among adults. Male is small and antennae is longer than the body length whereas female is stout and bigger and antenna is shorter than the body length. The pre-oviposition period of female was between 3-7 days and oviposition period ranged between 5 to 57 days. The fecundity ranged from 5 to 56 eggs. The post-oviposition period was to one to three days.

The data recorded on the life period of different stages are given below :

b) Seasonal incidence and extent of damage :

The egg laying was noticed from November to June on the trunk of the tree up to one meter height, on the exposed roots, on dried leaves and the soil adhering to the base of the tree. The eggs were seen in cracks and crevices of bark and space between branches emerging from ground level. Eggs were never noticed on the smooth surface of the tree.

The feeding on the bark by first instar grub could be located near the site of oviposition. In the beginning, powdery frass at the point of attack can be seen and gummosis can be noticed within few days of initial feeding. Trees above two years of age were found to be attacked by this pest. A single grub could kill a two year old cashew tree by extensive tunnelling the bark. More than 40 grubs were found damaging a single 15-20 year old tree.

Table 1 : Studies on life history of *P. ferrugineus*

Sex	Egg period (days)	Larval period (days)	Pupal period (days)	No. of days from egg to adult	No. of days from egg to adult death	Adult longivity (days)
Male	4-10	106-182	77-199	215-365	250-411	31-71
	(6-8)	(145.9)	(121.9)	(274 50)	(315.6)	(43.6)
Female	5-10	123-212	81-194	230-381	246-431	8-60
	(6.2)	(169.7)	(124.6)	(300.3)	(334.1)	(31.9)

Figures in parentheses indicate mean values

Field-emerged adults were noticed from November to June and were also attracted to fluroscence lamps during night time. In the laboratory, *P. ferrugineus* is able to complete the grubs phase on sap wood of cashew and Kapak tree (Ceiba pentandra). The sap wood of mango was not preferred by the grubs and all grubs were dead within 2 or 3 days.

C. Control

i) Biological control:

A fungal disease caused by *Metarhizium anisopliae* was observed on the grubs. The fungus was isolated and pathogenicity was also confirmed in the laboratory.

ii) Chemical control:

The chemical treatment consisted of stem padding treatment of monocrotophos @ 10, 20, 30 ml and raking of 500g HCH per tree in the soil around the bole region. The padding was done above the point of attack in the healthy tissue at one or more points according to nature and extent of damage by the insect. At each point, a flap of live bark for an area of 30 cm^2 (6x5 cm) was peeled out and a layer of absorbent cotton wool was inserted in between the flap and trunk region. Monocrotophos was slowly poured in the cotton wool. The bark was kept back and tied tightly. The cut ends were closed with fungicide (copper oxychloride) treated wet clay.

One trial at Aryapu, KCDC plantation and two trials at CPCRI, Vittal was conducted from 1983 to 1986. The results revealed that 31.3% and 62.5% control were achieved at Aryapu and Vittal, respectively when the treatment was given at the initial stage of infestation. The trees with medium and advanced stage infestations had shown least control.

iii) Atractant:

The silk cotton tree logs (1.5m long x 0.16 - 0.3m width) smeared with cashewnut shell liquid (CNSL) were placed in the endemic areas. The logs were placed at random during 1984 at an area of 10 ha during July-August (10 logs) and October-November (12 logs). Egg laying or orientation of the adult or infestation by grubs was not observed in all these logs. During 1985, the experiment was repeated with 20 logs in the same area in which one log was found infested by stem borer grubs. The cashew trees situated in the vicinity of CNSL treated silk cotton tree log, were also infested. The smell of CNSL was observed even after 4 months application.

d. Other Studies

During survey, in South Kanara district of Karnataka, *P. ferrugineus* L. was commonly encountered. However, two other species viz. *P. obesus* Gahan and *Batocera rufomaculeta* Dg. (Cerambycidae: Laoniinae) were also noticed in few locations.

Secondary infestation by jewel beetle, *Belinota prasina* Th. (Buprestidae) and species of scolytid beetle were seen on stem borer damaged cashew trees. Besides cashew, *P. ferrugineus* was found damaging silk cotton tree and *Diospyros* sp.

PERSONNEL

MANAGERIAL	
Scientist-in-charge	Dr. RC Mandal, Ph.D., Scientist S-4
Project Coordinator (Cashew)	Dr. EVV Bhaskara Rao, Ph. D., Scientist S-3
SCIENTIFIC	
Scientist S-3 (Agronomy)	Dr. RC Mandal, Ph. D. Scientists S-4
Scientist S-1 (Agronomy)	Sri N. Yadukumar, M. Sc. (Ag.) Scientist S-2
Scientist S-3 (Horticulture)	Dr. Room Singh, Ph. D. Scientist S-3
Scientist S-1 (Horticulture	Vacant
Scientist S-3 (plant Breeding)	Vacant
Scientist S-1 (plant Breeding)	Thimmappaiah, M. Sc. (Ag.) Scientist S-2
Scientist S-2 (Entomology)	Dr. PSPV Vidyasagar, Ph. D. Scientist S-2 (upto 5-10-1987) Sri D. Sundararaju, M. Sc. (Ag.) w.e.f. 5-10-1987
Scientist S-1 (Entomology)	Vacant
Scientist S-2 (Extension)	Dr. KRM Swamy, Ph. D., Scientist S-2
Scientist S-2 (Biochemistry)	Dr. KV Nagaraja, Ph.D., Scientist S-2
Scientist S-2 (Soil Chemistry)	Vacant
Scientist S-2 (Statistics)	Sri S. Bhagavan, M. Sc., Scientist S-2
TECHNICAL	
Farm Superintendent	E. Mohan, M. Sc. (T-6)
Farm Superintendent	B. Nagaraja B.Sc.(Ag) (T-6) (w.e.f.3-11-1987)
Technical Officer	Vacant
ADMINISTRATION	
Assistant Administrative Officer	Jane Frances Mary Lewis (w. e. f. 17-8-1987)
Assistant Accounts Officer	Vacant
Office Superintendent	A. Keshava Shabaraya (w. e. f. 19-10-1987)

APPENDIX II

PARTICIPATION IN SYMPOSIA/CONFERENCES

1.	Review meeting on Cashew Development Programmes in India, Bangalore.	EVVB Rao	1st February
2.	12th Meeting of the Indian Cashew Development Council, Bangalore.	EVVB Rao	2nd February
3.	National Symposium on Plant Genetic Resources, NBPGR, New Delhi	PM Kumaran EVVB Rao	3-6 March
4.	8th Biennial Workshop of All India Coordinated Research Project on Palms & Cashew	RC Mandal EVVB Rao KRM Swamy Room Singh D Sundararaju	24-27 October

APPENDIX III

RESEARCH PUBLICATIONS:

1. Bavappa, KVA and Bhaskara Rao, EVV. 1987. Genetic diversity in plantation crops - Their collection and utilization. Invited paper presented in National Symposium on plant Genetic Resources: 3-6 March 1987, NBPGR, New Delhi.
2. Bhaskara Rao, EVV. 1987. Cashew in India : Invited article sent for special Issue of Orissa Agric. J. (In press)
3. Bopaiah, BM, Nagaraja, KV and Shantharam, MV. 1987. Biogas production from cocoa pod husk. 10th International Cocoa Research Conference Proceedings. 857-859.
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5. Nagaraja, KV 1987. Proteins of high yielding varieties of cashew. Plant Foods for Human Nutrition 37, 69-75.
6. Nagaraja, KV. 1987. Lipids of high yielding varieties of cashew. Plant Foods for Human Nutrition 37, 307-311.
7. Thimmappaiah and Suman, C.L. 1987. Sex in relation to fruit set and fruit yield in mango (*Mangifera indica* L.). Punjab Hort. J. 27 (1-2): 8-11.

TECHNICAL PUBLICATIONS

1. Summary report on MSCP project (Consolidated Report) for the period ended 30-9-1986 (Ed : Bhaskara Rao EVV)
2. Annual Report 1985-86 of All India Coordinated Cashew Improvement project (Ed : Bhaskara Rao EVV)
3. Annual Report 1986-87 of AICCIP (Ed : Bhaskara Rao EVV)
4. Summary Report 1985-87 of AICCIP (Agenda papers etc. for presentation in 8th Workshop) (Ed : Bhaskara Rao EVV)